

Prayoga worksheets: Chemistry

13 experiments · Predict, Measure, Observe, Explain · draft 16 October 2026

Prayoga in Chemistry at a glance

Class	Chapters	Board practicals	Prayoga experiments	What's new with Prayoga
Class 10	5	9	8 across 4 chapters	pH as a number, the heat of a reaction as a live curve, gas measured by a pressure sensor
Class 9	4	5	4 across 2 chapters	Full heating curve from ice to boiling water drawn live; physical and chemical changes backed by measurements
Classes 6–8	Textbook topics	No board list	1	Kitchen acids and bases sorted by real readings
Total			13 experiments	One kit + phone, by cable or Bluetooth, no battery inside; live graphs in Kannada; a worksheet for every experiment

Chapters: science chapters in that class's textbook. Board practicals: practicals the board prescribes. Prayoga experiments: every worksheet in this file for that class.

Prayoga experiments chapter by chapter

Class	Chapter or topic	Prayoga experiments (worksheet number)
10	Chemical Reactions and Equations	1 Hot and cold reactions
10	Acids, Bases and Salts	2 pH of everyday things; 3 Neutralisation curve; 4 Natural indicator from red cabbage; 7 Properties of hydrochloric acid and sodium hydroxide
10	Metals and Non-metals	5 Metals and non-metals: which conduct?
10	Carbon and its Compounds	6 Salt water and sugar water; 8 Properties of ethanoic acid
9	Matter in Our Surroundings	9 Heating curve of ice; 10 Evaporation causes cooling
9	Is Matter Around Us Pure	11 Solutions, colloids and suspensions; 12 Physical and chemical changes
6–8	Acids, Bases and Salts	13 Acid or base in the kitchen

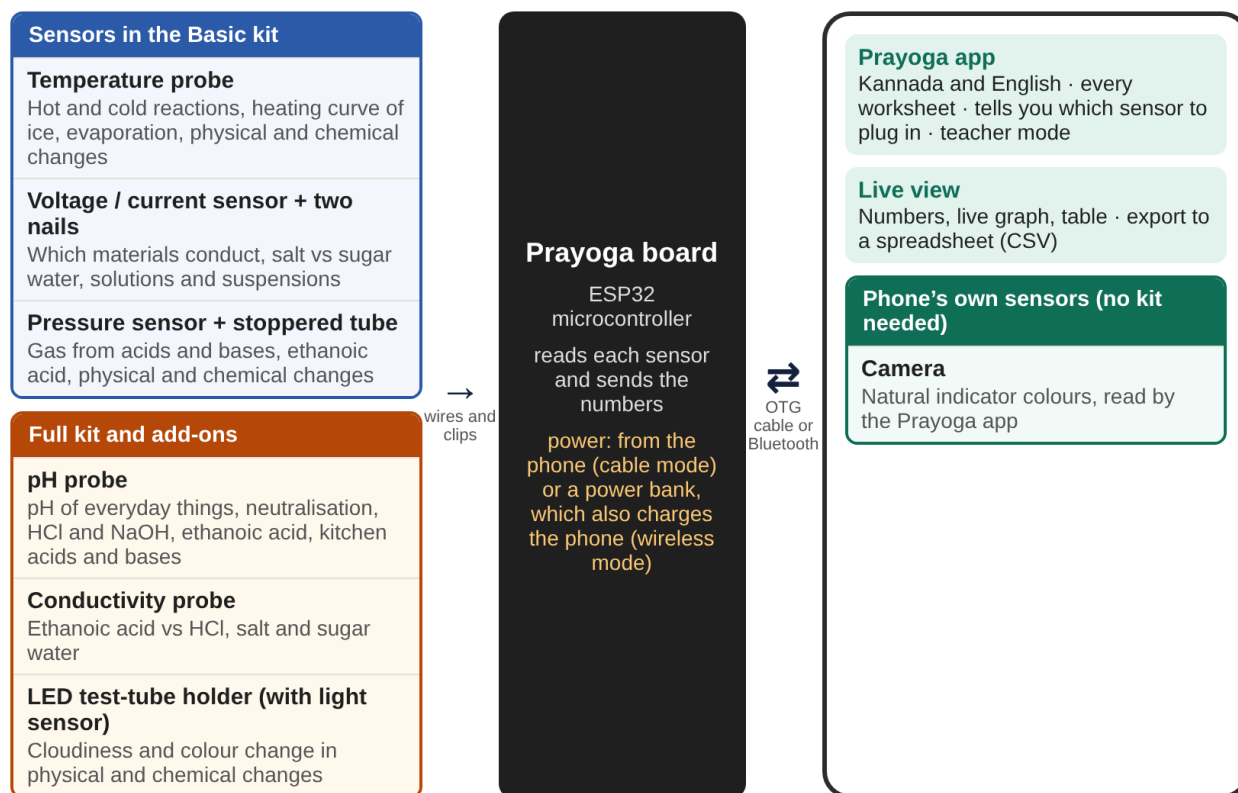
How to use these worksheets

1. **Print** each worksheet on both sides of one sheet. Front: a picture of the setup and every instrument, then predict, measure, set up and record. Back: the graph to plot and the questions.
2. **Before class**, the teacher tries the experiment once, charges the phones, and checks the label under the title. It says what the worksheet needs: the Basic kit, the Full kit, only the phone, by hand, or the shared USB microscope.
3. **In class**, groups of 5–6 work through the four steps in order: Predict, Measure by hand, Set up Prayoga and observe, Explain. Nobody opens the app until predictions are written.
4. **Students plot by hand first**, then compare with the app's live graph. The hand reading and hand graph keep the skills the exam tests.
5. **After class**, collect the sheets and mark them with the answer key at the end of this file.

Prayoga for Chemistry

Prayoga for Chemistry: how the parts work together

Sensors measure → the Prayoga board reads them five times a second → the phone shows live numbers and graphs. Cable mode: the phone powers the kit. Wireless mode: a power bank powers the kit and charges the phone, with data over Bluetooth.



By hand, alongside Prayoga: pH paper, litmus, turmeric paper, cabbage juice, limewater, lab thermometer, measuring cylinder, torch. Students take these readings first, then check them against the sensor.

Setting up Prayoga (every experiment that uses the kit)

1. Plug the sensor or probe named on the worksheet into the kit (the "Set up Prayoga" box says which).
2. Connect the kit in one of two ways. **Cable mode:** plug the kit into the phone with the USB OTG cable; the phone powers the kit and the readings travel through the cable, so no other power is needed. **Wireless mode:** plug a power bank or 5 V charger into the kit's POWER IN port and connect by Bluetooth in the app; the phone can charge from the kit's CHARGE OUT port at the same time. Each kit has its own name (for example Prayoga-07), so groups connect to the right one.
3. Open the **Prayoga app** and choose the subject, class and experiment. The app shows which sensor to plug in and opens the right view.
4. Tap **Start** to record and **Stop** to finish, then **Save**. Saved readings can be shared as a spreadsheet. Experiments that use only the phone's own sensors (motion, sound, magnetism, camera) need no kit.

The four steps on every worksheet

Step	What students do
1 Predict	Write what they expect and why, and sketch the graph, before touching the kit.
2 Measure by hand	Use a thermometer, multimeter, scale, stopwatch or pH paper, and work out its least count. This keeps the instrument skills the exam tests.
3 Set up Prayoga and observe	Follow the "Set up Prayoga" box, run the experiment, fill the table, plot by hand, then compare with the app.
4 Explain	Compare with the prediction, explain differences, answer exam-style questions.

In class

- One kit per group of 5–6 students. Roles, rotated each time: **Builder**, **Reader** (plain instrument), **App operator**, **Recorder**, **Explainer**.
- A 40-minute period: predict 5 min · hand reading 5 min · observe and plot 15 min · explain 10 min · report back 5 min. Long experiments (over hours or days) are started in one period and finished later.
- The label under each title says what is needed. **Basic kit**: board, voltage/current sensor, temperature probe, light sensor, pressure sensor, buzzer and circuit parts. **Full kit**: adds pH and conductivity probes, clip-on microscope lens, coil and magnet, solar cell, grating film, IR sensors and the LED test-tube holder. **Lab add-on**: one USB microscope shared by the school.
- Teacher answers are at the end of this file.

Worksheets (13; 7 need only the Basic kit, the phone or hand methods)

No.	Worksheet	Class	Chapter	Status
1	Hot and cold reactions	Class 10	Chemical Reactions and Equations	Basic kit
2	pH of everyday things	Class 10	Acids, Bases and Salts	Full kit
3	Neutralisation curve	Class 10	Acids, Bases and Salts	Full kit
4	Natural indicator from red cabbage	Class 10	Acids, Bases and Salts	Phone only (Prayoga app)
5	Metals and non-metals: which conduct?	Class 10	Metals and Non-metals	Basic kit
6	Salt water and sugar water	Class 10	Carbon and its Compounds	Basic kit
7	Properties of hydrochloric acid and sodium hydroxide	Class 10	Acids, Bases and Salts	Full kit
8	Properties of ethanoic acid	Class 10	Carbon and its Compounds	Full kit
9	Heating curve of ice	Class 9	Matter in Our Surroundings	Basic kit
10	Evaporation causes cooling	Class 9	Matter in Our Surroundings	Basic kit
11	Solutions, colloids and suspensions	Class 9	Is Matter Around Us Pure	Basic kit
12	Physical and chemical changes	Class 9	Matter: physical and chemical changes	Full kit
13	Acid or base in the kitchen	Class 7	Acids, Bases and Salts	Full kit (or by eye)

This page is left blank so each worksheet prints on the front and back of one sheet.

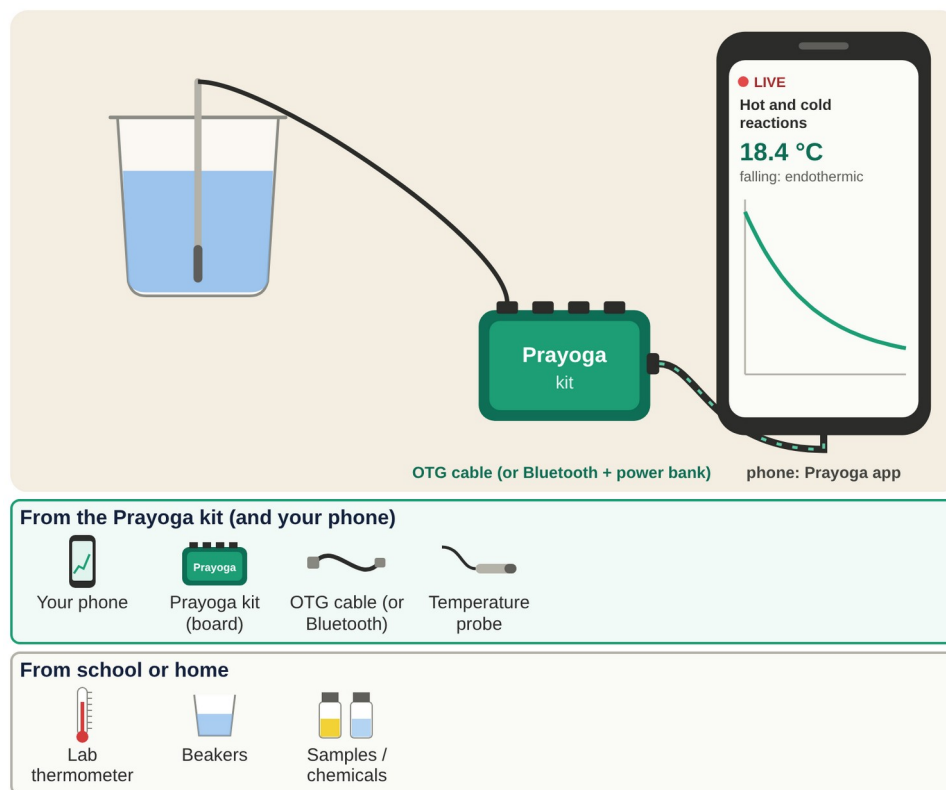
1. Hot and cold reactions

Class 10 • Chemical Reactions and Equations Basic kit

Name _____ Class _____ Group _____ Date _____

You need: Prayoga kit (temperature probe), lab thermometer, beakers, water, vinegar, baking soda, ammonium chloride (if available), a little quicklime (teacher only).

Safety: Quicklime is caustic and gets very hot: teacher only, a small amount, goggles. Do not touch or taste chemicals.

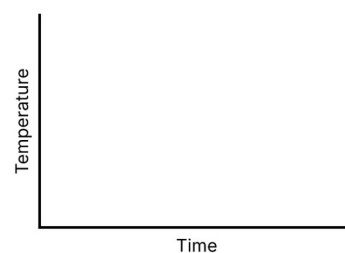


Above: how the parts connect, and every instrument you need. The animated version is on the Prayoga setup page.

1 Predict (before you touch the kit)

Adding baking soda to vinegar will make the liquid: ☐ warmer ☐ cooler ☐ no change

Why do you think so?



Sketch the graph you expect

2 Measure by hand

1. Read the starting temperature of each beaker on the thermometer: _____ °C.

3 Set up Prayoga, then observe

Set up Prayoga

- Plug the temperature probe into the kit.
- Connect the kit: OTG cable to the phone (cable mode), or power bank in and Bluetooth on (wireless mode). Open the Prayoga app and choose this experiment. It opens the **Temperature** view and draws the live graph. Check it shows room temperature before you start.
- Tap Start to record and Stop to finish. Tap Save to keep the readings; they can be shared as a spreadsheet.

1. Put the probe in 50 mL of vinegar; add one spoon of baking soda and stir. Record the lowest temperature.
2. Repeat with ammonium chloride in water, and (teacher) quicklime in water. Record the highest or lowest temperature.

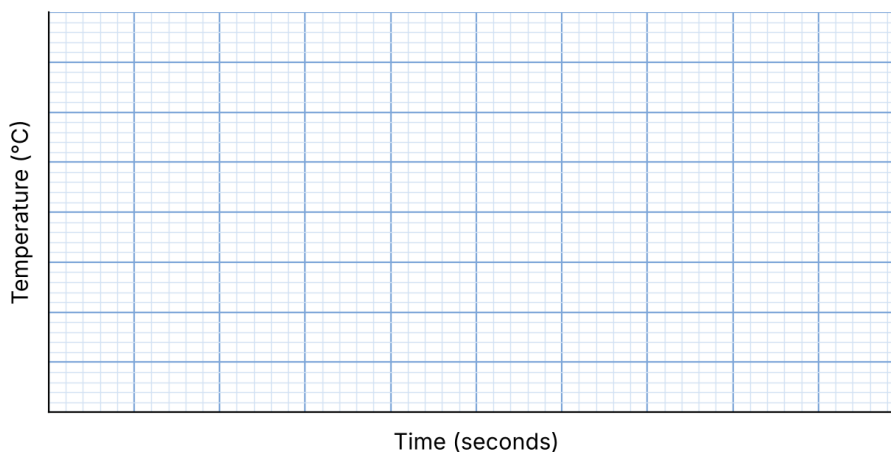
Write your readings in the table on the back.

3 Record your readings · Hot and cold reactions

Reaction	Start (°C)	Highest or lowest (°C)	Change (°C)	Exothermic or endothermic?
Vinegar + baking soda				
Ammonium chloride + water				
Quicklime + water (teacher)				

3 Plot your results · Hot and cold reactions

Plot your points by hand and draw the best line or smooth curve. Choose a scale that uses most of the grid. Then compare with the app's graph.



4 Explain

a) Was your prediction right? If not, what changed your mind?

b) Where does the heat come from in an exothermic reaction?

c) Name one exothermic process that happens in your body.

Exam-style questions

1. Write the balanced equation for quicklime reacting with water. Name the type of reaction. (2 marks)

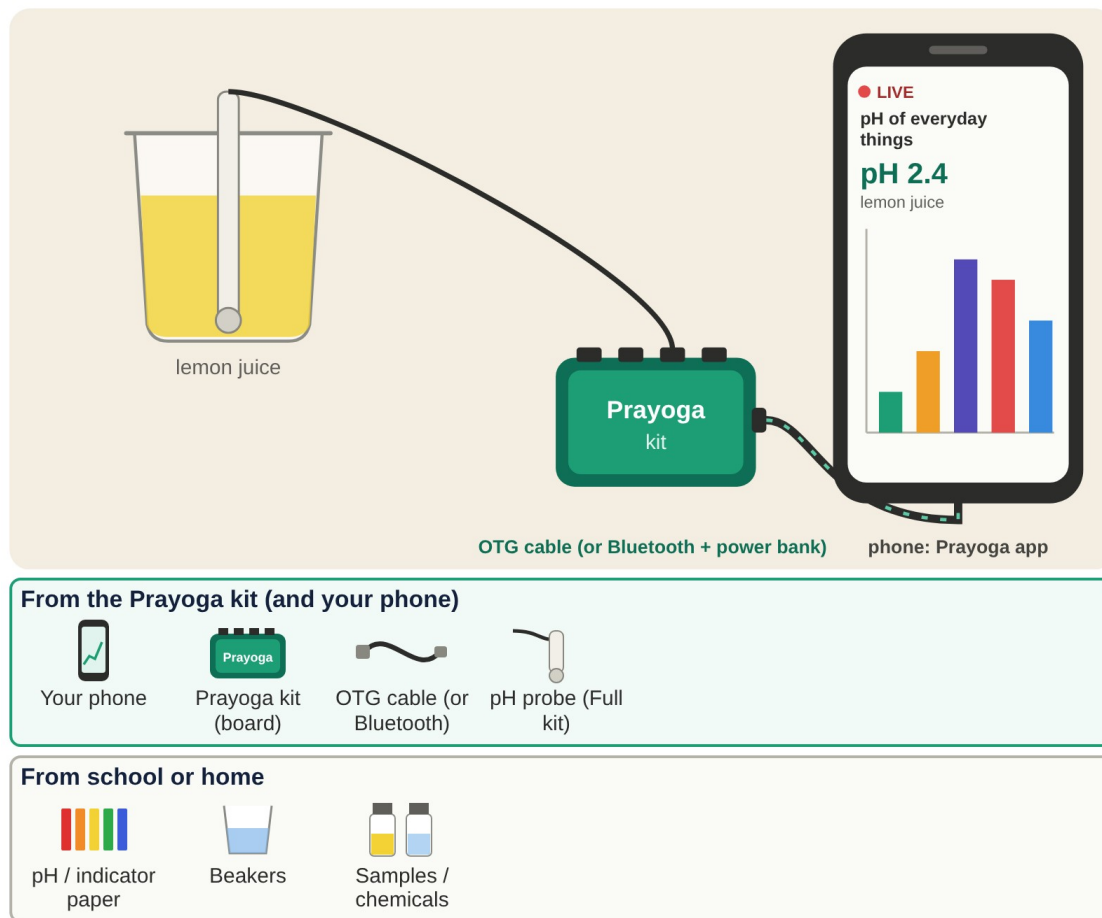
2. What is an endothermic reaction? Give one example. (2 marks)

2. pH of everyday things

Class 10 • Acids, Bases and Salts **Full kit**

Name _____ Class _____ Group _____ Date _____

You need: pH probe, pH paper with colour chart, clean water for rinsing; lemon juice, vinegar, curd, tap water, soap solution, baking soda solution, toothpaste in water.



Above: how the parts connect, and every instrument you need. The animated version is on the Prayoga setup page.

1 Predict (before you touch the kit)

Which is most acidic? ☐ lemon juice ☐ curd ☐ soap solution

Why do you think so?

2 Measure by hand

1. Dip pH paper in each sample and match the colour with the chart.

3 Set up Prayoga, then observe

Set up Prayoga

- Plug the pH probe into the kit; rinse it in clean water.
- Connect the kit: OTG cable to the phone (cable mode), or power bank in and Bluetooth on (wireless mode). Open the Prayoga app and choose this experiment. It opens the pH view and draws the live graph. Calibrate in pH 7 buffer when the app asks.
- Students also use pH paper, as the textbook asks.

1. Rinse the probe in clean water; dip in the first sample; wait for a steady reading.
2. Rinse between samples. Record both readings.

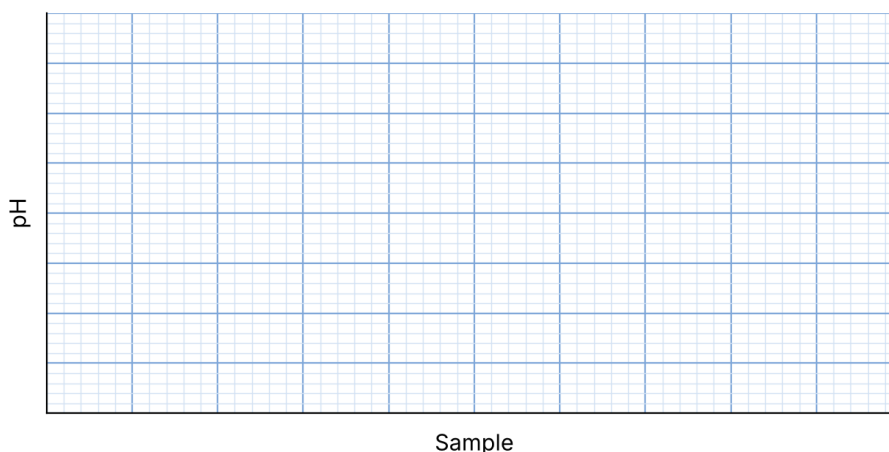
Write your readings in the table on the back.

3 Record your readings · pH of everyday things

Sample	pH paper	pH probe	Acidic / neutral / basic
Lemon juice			
Vinegar			
Curd			
Tap water			
Soap solution			
Baking soda solution			
Toothpaste in water			

3 Plot your results · pH of everyday things

Draw a bar chart by hand. Choose a scale that uses most of the grid. Then compare with the app's graph.



4 Explain

a) Was your prediction right? If not, what changed your mind?

b) Did the paper and the probe agree? Which is more precise?

c) Why do we brush with toothpaste after eating?

Exam-style questions

1. A solution turns red litmus blue. Its pH is likely to be: (a) 1 (b) 4 (c) 5 (d) 10 (1 mark)

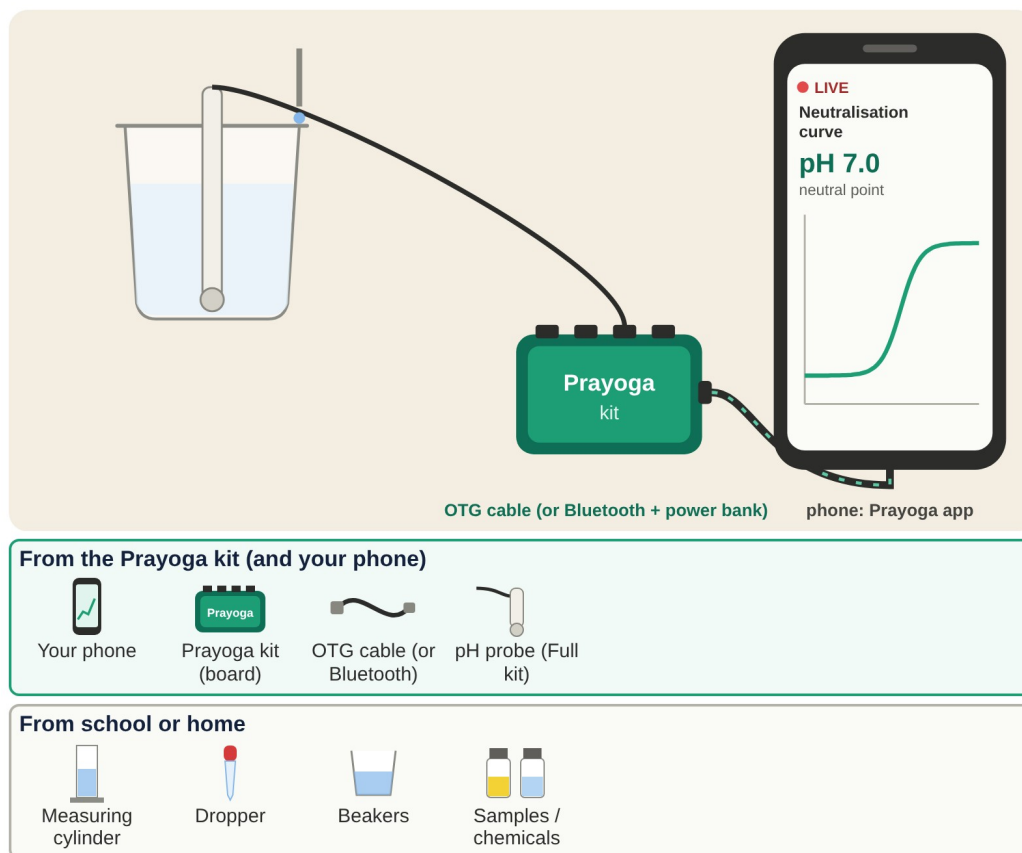
2. Why does tooth decay start when the pH in the mouth falls below 5.5? (2 marks)

3. Neutralisation curve

Class 10 • Acids, Bases and Salts **Full kit**

Name _____ Class _____ Group _____ Date _____

You need: pH probe (or pH paper), 20 mL vinegar, baking soda solution (1 teaspoon in 50 mL water), dropper, measuring cylinder, beaker, stirrer.

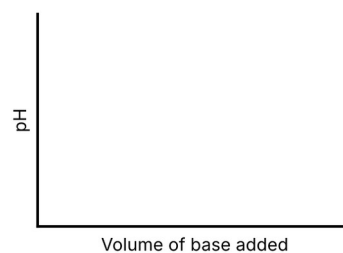


Above: how the parts connect, and every instrument you need. The animated version is on the Prayoga setup page.

1 Predict (before you touch the kit)

As base is added, the pH will: ☐ rise slowly, then quickly ☐ rise in a straight line ☐ fall

Why do you think so?



Sketch the graph you expect

2 Measure by hand

1. Measure 20 mL vinegar in the measuring cylinder, reading the bottom of the curved surface (meniscus) at eye level.

3 Set up Prayoga, then observe

Set up Prayoga

- Plug the pH probe into the kit; rinse it in clean water.
- Connect the kit: OTG cable to the phone (cable mode), or power bank in and Bluetooth on (wireless mode). Open the Prayoga app and choose this experiment. It opens the **pH** view and draws the live graph. Calibrate in pH 7 buffer when the app asks.
- Students also use pH paper, as the textbook asks.

1. Put the probe in the vinegar. Add baking soda solution 1 mL at a time; stir and record the pH.
2. Near pH 6–8, add 0.5 mL at a time.

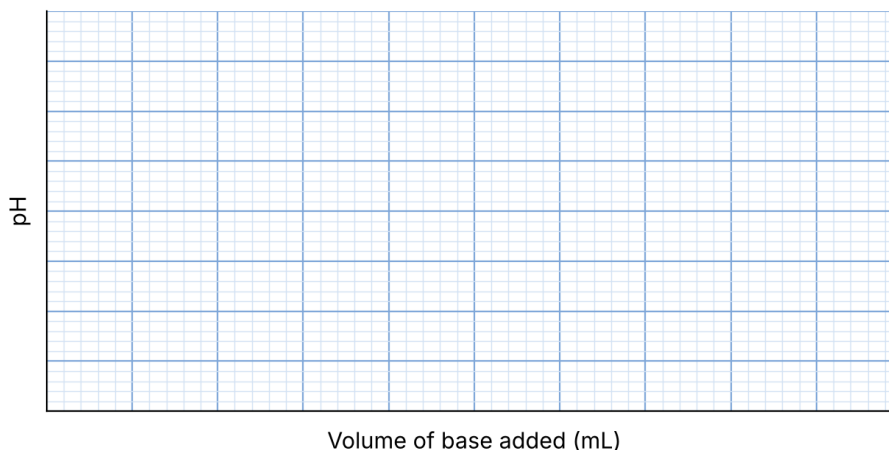
Write your readings in the table on the back.

3 Record your readings • Neutralisation curve

Base (mL)	pH	Base (mL)	pH
0		7	
1		8	
2		9	
3		10	
4		11	
5		12	
6		13	

3 Plot your results • Neutralisation curve

Plot your points by hand and draw the best line or smooth curve. Choose a scale that uses most of the grid. Then compare with the app's graph.



4 Explain

a) Was your prediction right? If not, what changed your mind?

b) At what volume did the pH reach 7 (the neutral point)?

c) Why does the pH change slowly at first?

Exam-style questions

1. Write the word equation for the reaction of an acid with a base. (1 mark)

2. Give two examples of neutralisation in daily life. (2 marks)

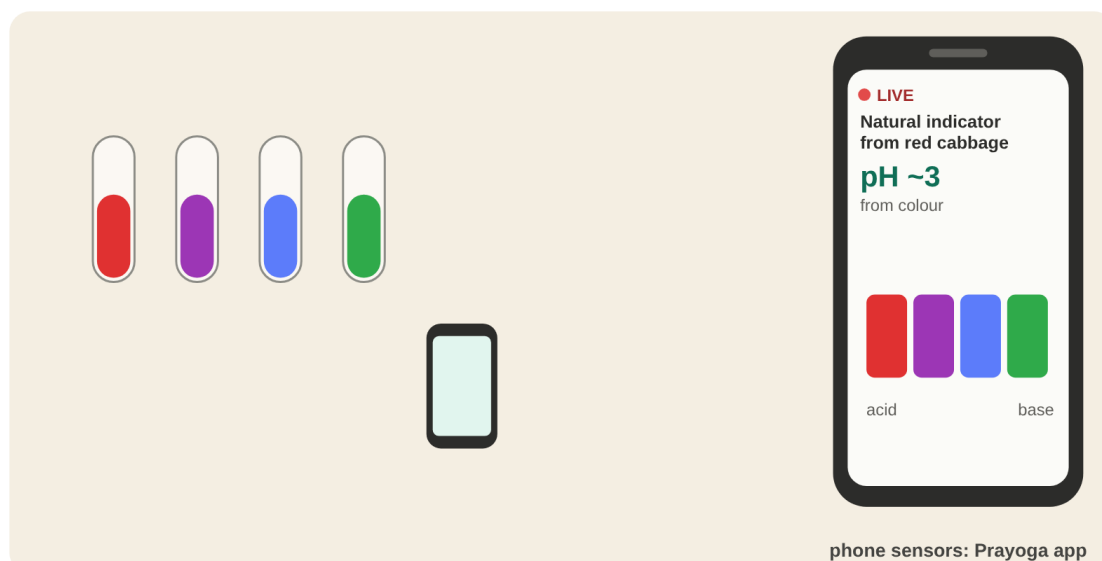
4. Natural indicator from red cabbage

Class 10 • Acids, Bases and Salts **Phone only (Prayoga app)**

Name _____ Class _____ Group _____ Date _____

You need: Red cabbage leaves (or beetroot, hibiscus, turmeric), hot water (teacher), glasses or test tubes, white paper, phone camera; lemon juice, vinegar, water, soap solution, baking soda solution.

Safety: Only the teacher handles hot water.



From the Prayoga kit (and your phone)



Your phone

From school or home



Test tubes or glasses



Samples / chemicals



Paper, card, materials

Above: how the parts connect, and every instrument you need. The animated version is on the Prayoga setup page.

1 Predict (before you touch the kit)

In soap solution, purple cabbage juice will turn: ☐ red ☐ purple ☐ green

Why do you think so?

2 Measure by hand

1. Put white paper behind the glasses. Compare each colour with a pH-paper chart.

3 Set up Prayoga, then observe

Set up Prayoga

- Line up the samples on white paper in good daylight.
- Open the Prayoga app and choose this experiment. The **Colour** view reads each sample's colour through the camera and estimates the pH.

1. Soak chopped cabbage in hot water for 10 minutes; strain and cool the purple juice.
2. Add the same amount of juice to each sample. Photograph them in a row on white paper.

Write your readings in the table on the back.

3 Record your readings · Natural indicator from red cabbage

Sample	Colour by eye	Colour in photo	Acid / neutral / base
Lemon juice			
Vinegar			
Water			
Soap solution			
Baking soda solution			

4 Explain

a) Was your prediction right? If not, what changed your mind?

b) Why is a natural indicator useful in a school without lab chemicals?

c) Turmeric turns red-brown in soap solution. What does that tell you about soap?

Exam-style questions

1. Name two natural indicators. (1 mark)

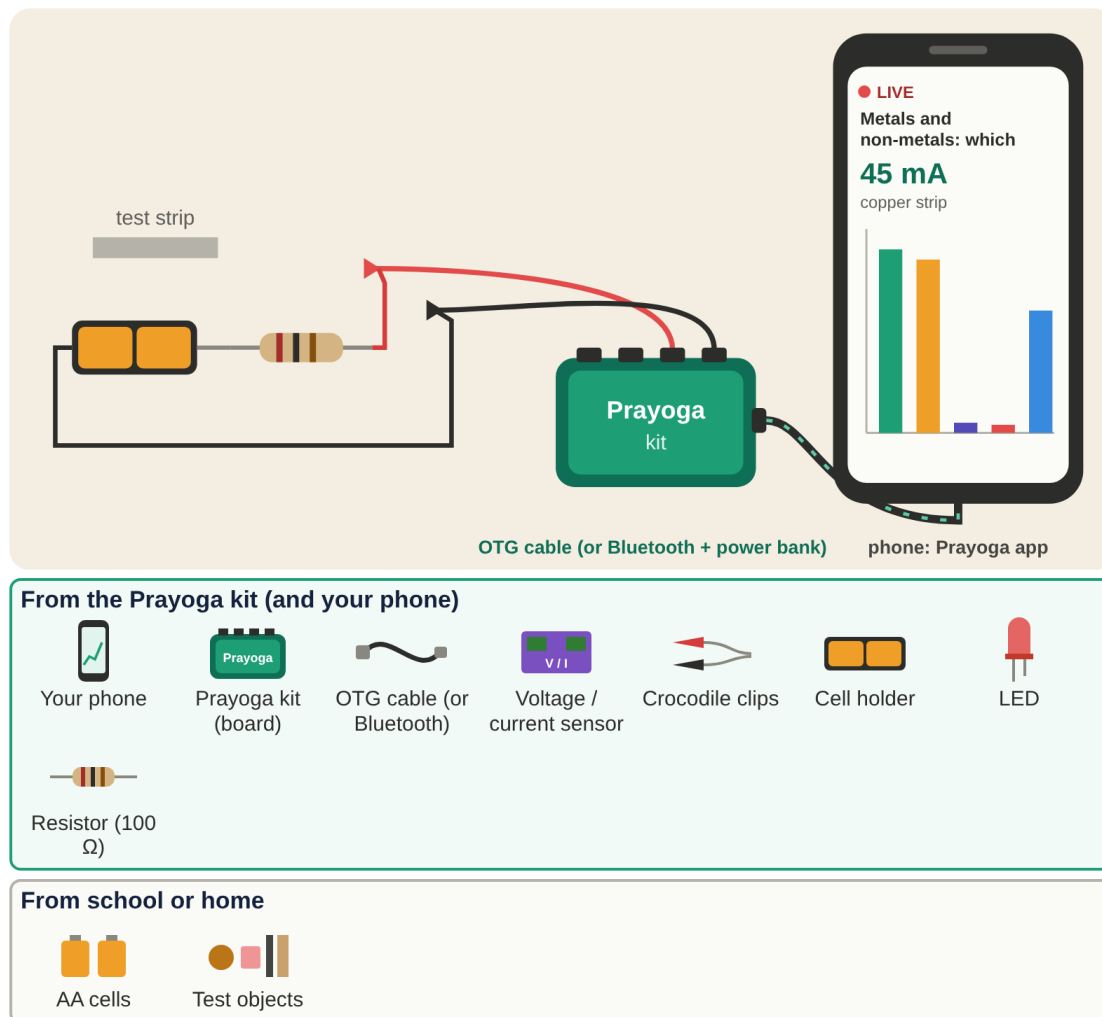
2. What are olfactory indicators? Give one example. (2 marks)

5. Metals and non-metals: which conduct?

Class 10 • Metals and Non-metals **Basic kit**

Name _____ Class _____ Group _____ Date _____

You need: Prayoga kit, holder for 2 AA cells, LED with 100 Ω resistor, crocodile clips; copper wire, aluminium foil, iron nail, pencil lead (graphite), charcoal, plastic, wood.



Above: how the parts connect, and every instrument you need. The animated version is on the Prayoga setup page.

1 Predict (before you touch the kit)

Which non-metal will conduct electricity? ☐ none ☐ graphite ☐ charcoal

Why do you think so?

2 Measure by hand

1. Look at each: is it shiny? Try to bend it: does it bend or break?

3 Set up Prayoga, then observe

Set up Prayoga

- Build the test circuit: battery + $\rightarrow$ VIN+; VIN- $\rightarrow$ LED with 100 Ω resistor $\rightarrow$ clip A; clip B $\rightarrow$ battery - and kit GND.
- Connect the kit: OTG cable to the phone (cable mode), or power bank in and Bluetooth on (wireless mode). Open the Prayoga app and choose this experiment. It opens the **Voltage and current** view and draws the live graph.
- Tap Start to record and Stop to finish. Tap Save to keep the readings; they can be shared as a spreadsheet.

1. Place each material across the gap between the clips.
2. Read the current.

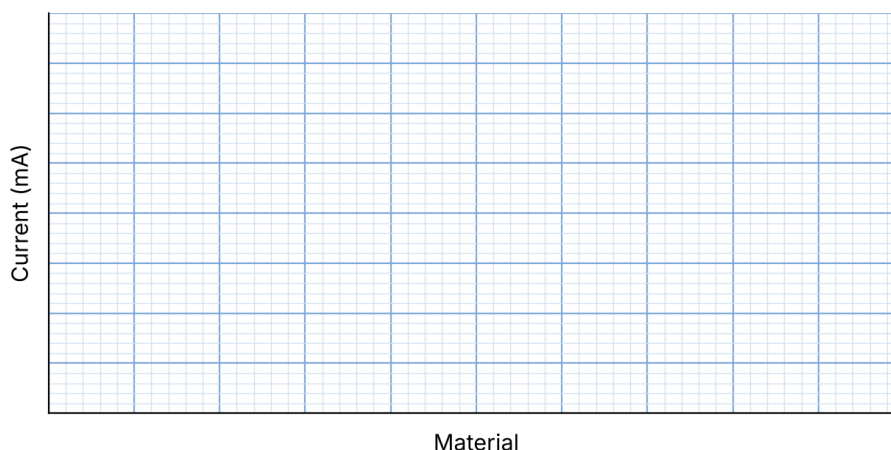
Write your readings in the table on the back.

3 Record your readings • Metals and non-metals: which conduct?

Material	Shiny?	Bends or breaks?	Current (mA)	Metal or non-metal?
Copper wire				
Aluminium foil				
Iron nail				
Pencil lead				
Charcoal				
Plastic				
Wood				

3 Plot your results • Metals and non-metals: which conduct?

Draw a bar chart by hand. Choose a scale that uses most of the grid. Then compare with the app's graph.



4 Explain

a) Was your prediction right? If not, what changed your mind?

b) Which properties go together for metals?

c) Which result does not fit the pattern? Why?

Exam-style questions

1. Name a non-metal that conducts electricity and a metal that is liquid at room temperature. (1 mark)

2. Why are electric wires made of copper or aluminium? (2 marks)

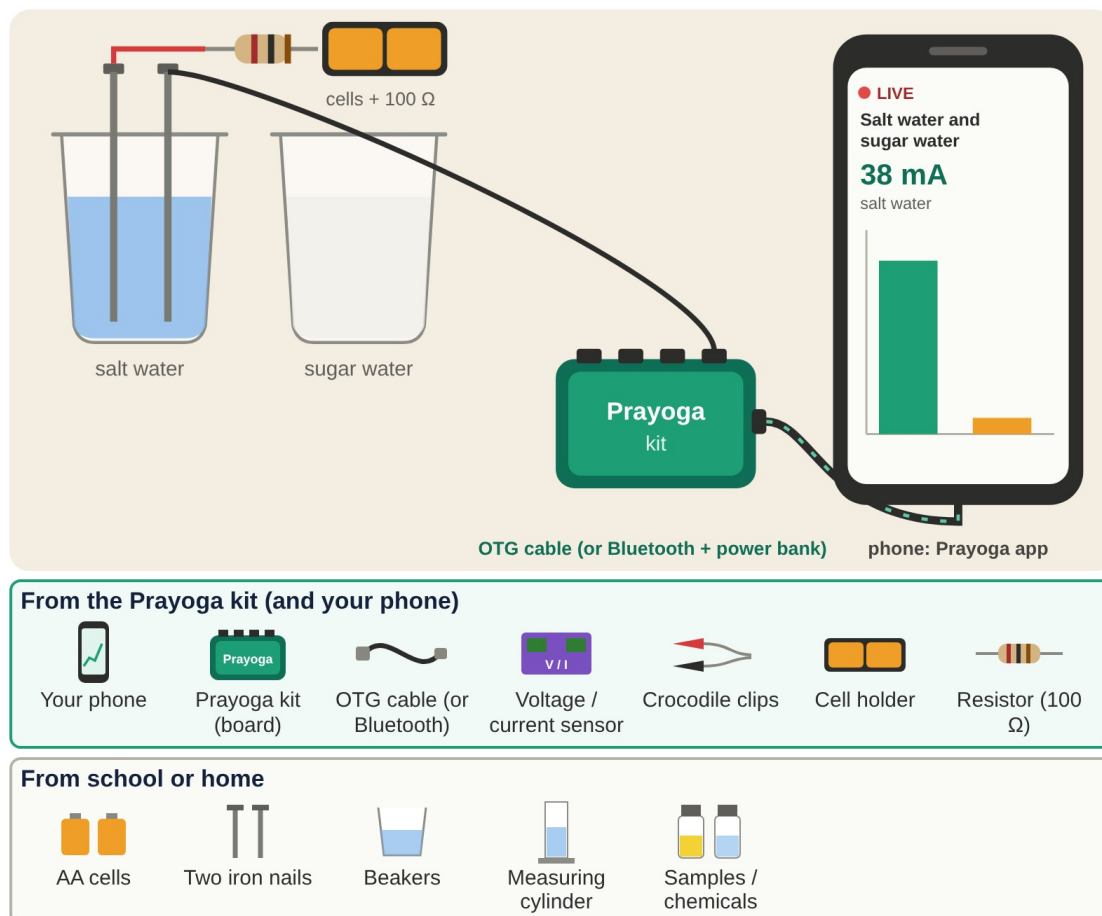
6. Salt water and sugar water

Class 10 • Carbon and its Compounds **Basic kit**

Name _____ Class _____ Group _____ Date _____

You need: Prayoga kit, holder for 4 AA cells, 100 Ω resistor, two clean iron nails, beakers, clean water, salt, sugar, measuring cylinder, teaspoon.

Safety: Low voltage only. Rinse and dry the nails between samples.



Above: how the parts connect, and every instrument you need. The animated version is on the Prayoga setup page.

1 Predict (before you touch the kit)

Which will conduct electricity? ☐ salt water ☐ sugar water ☐ both ☐ neither

Why do you think so?

2 Measure by hand

1. Measure 100 mL water in each beaker with the measuring cylinder; use level teaspoons.

3 Set up Prayoga, then observe

Set up Prayoga

- Build the circuit: battery + $\rightarrow$ 100 Ω resistor $\rightarrow$ VIN+; VIN- $\rightarrow$ nail 1; nail 2 $\rightarrow$ battery - and kit GND.
- Connect the kit: OTG cable to the phone (cable mode), or power bank in and Bluetooth on (wireless mode). Open the Prayoga app and choose this experiment. It opens the **Voltage and current** view and draws the live graph. Read the current (mA).
- Tap Start to record and Stop to finish. Tap Save to keep the readings; they can be shared as a spreadsheet.

1. Battery + $\rightarrow$ 100 Ω resistor $\rightarrow$ VIN+; VIN- $\rightarrow$ nail 1; nail 2 $\rightarrow$ battery - and kit GND. Hold the nails 2 cm apart at the same depth.
2. Dip the nails in each sample and read the current.

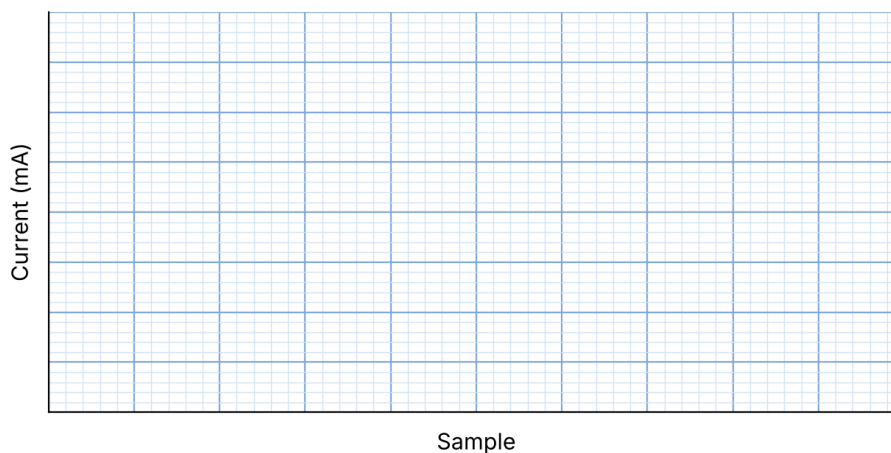
Write your readings in the table on the back.

3 Record your readings • Salt water and sugar water

Sample	Current with nails (mA)	Conductivity probe (if available)	Ionic or covalent?
Clean water			
Salt water, 1 teaspoon			
Salt water, 2 teaspoons			
Sugar water, 1 teaspoon			

3 Plot your results • Salt water and sugar water

Draw a bar chart by hand. Choose a scale that uses most of the grid. Then compare with the app's graph.



4 Explain

a) Was your prediction right? If not, what changed your mind?

b) Why does more salt give more current?

c) Why does sugar water hardly conduct?

Exam-style questions

1. Why do covalent compounds generally not conduct electricity? (2 marks)

2. Name the type of bonding in sodium chloride and in sugar. (1 mark)

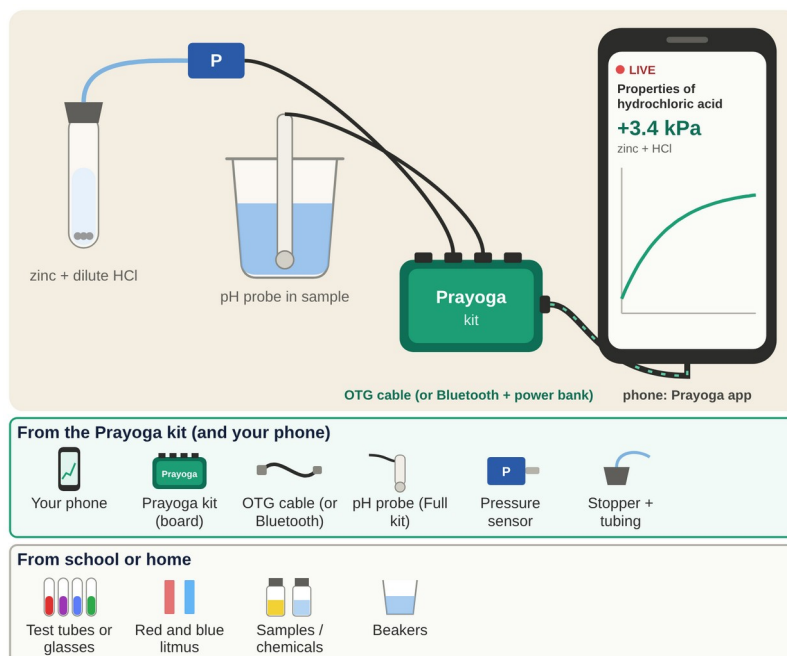
7. Properties of hydrochloric acid and sodium hydroxide

Class 10 • Acids, Bases and Salts **Full kit**

Name _____ Class _____ Group _____ Date _____

You need: Prayoga kit: pH probe (Full kit) and pressure sensor; test tubes, a one-hole stopper with tube; dilute HCl, dilute NaOH, red and blue litmus, zinc granules, sodium carbonate, limewater, matchstick (teacher).

Safety: Goggles on. The teacher handles acids and bases. Hydrogen burns: test only a small amount, with the teacher holding the match.



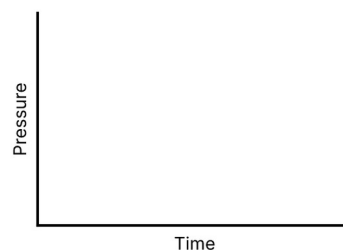
Above: how the parts connect, and every instrument you need. The animated version is on the Prayoga setup page.

1 Predict (before you touch the kit)

Zinc is added to dilute HCl in a closed tube. The pressure inside will:

☐ rise ☐ fall ☐ stay the same

Why do you think so?



Sketch the graph you expect

2 Measure by hand

1. Test each solution with red and blue litmus and write the colours in the table.

3 Set up Prayoga, then observe

Set up Prayoga

- Plug in the pH probe; fit the stopper and tube onto the pressure sensor.
- Connect the kit: OTG cable to the phone (cable mode), or power bank in and Bluetooth on (wireless mode). Open the Prayoga app and choose this experiment. It opens the **pH and pressure** view and draws the live graph. Calibrate the pH probe in pH 7 buffer when the app asks.
- Tap Start to record and Stop to finish. Tap Save to keep the readings; they can be shared as a spreadsheet.

1. Measure the pH of HCl and of NaOH with the probe; rinse it in between.
2. Put 5 mL HCl and two zinc granules in a tube and close it with the stopper joined to the pressure sensor. Record for 2 minutes. The teacher then tests the gas with a lit match.
3. Repeat with a spoon of sodium carbonate in fresh HCl, and pass the gas through limewater.
4. Repeat both tests with NaOH (the teacher may warm the zinc and NaOH gently).

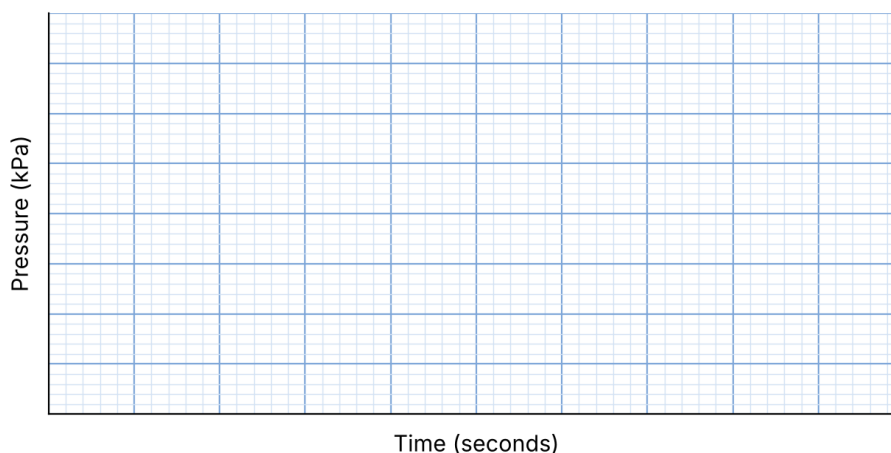
Write your readings in the table on the back.

3 Record your readings • Properties of hydrochloric acid and sodium hydroxide

Test	Dilute HCl	Dilute NaOH
Red litmus		
Blue litmus		
pH probe		
Zinc: pressure rise (kPa)		
Zinc: gas test (match)		
Sodium carbonate: pressure rise (kPa)		
Sodium carbonate: limewater		

3 Plot your results • Properties of hydrochloric acid and sodium hydroxide

Plot your points by hand and draw the best line or smooth curve. Choose a scale that uses most of the grid. Then compare with the app's graph.



4 Explain

a) Was your prediction right? If not, what changed your mind?

b) Which gas made the “pop”? Which gas turned limewater milky?

c) Why did NaOH give no gas with sodium carbonate?

Exam-style questions

1. Write the balanced equation for zinc reacting with dilute hydrochloric acid. (2 marks)

2. What happens when carbon dioxide is passed through limewater? Write the equation. (2 marks)

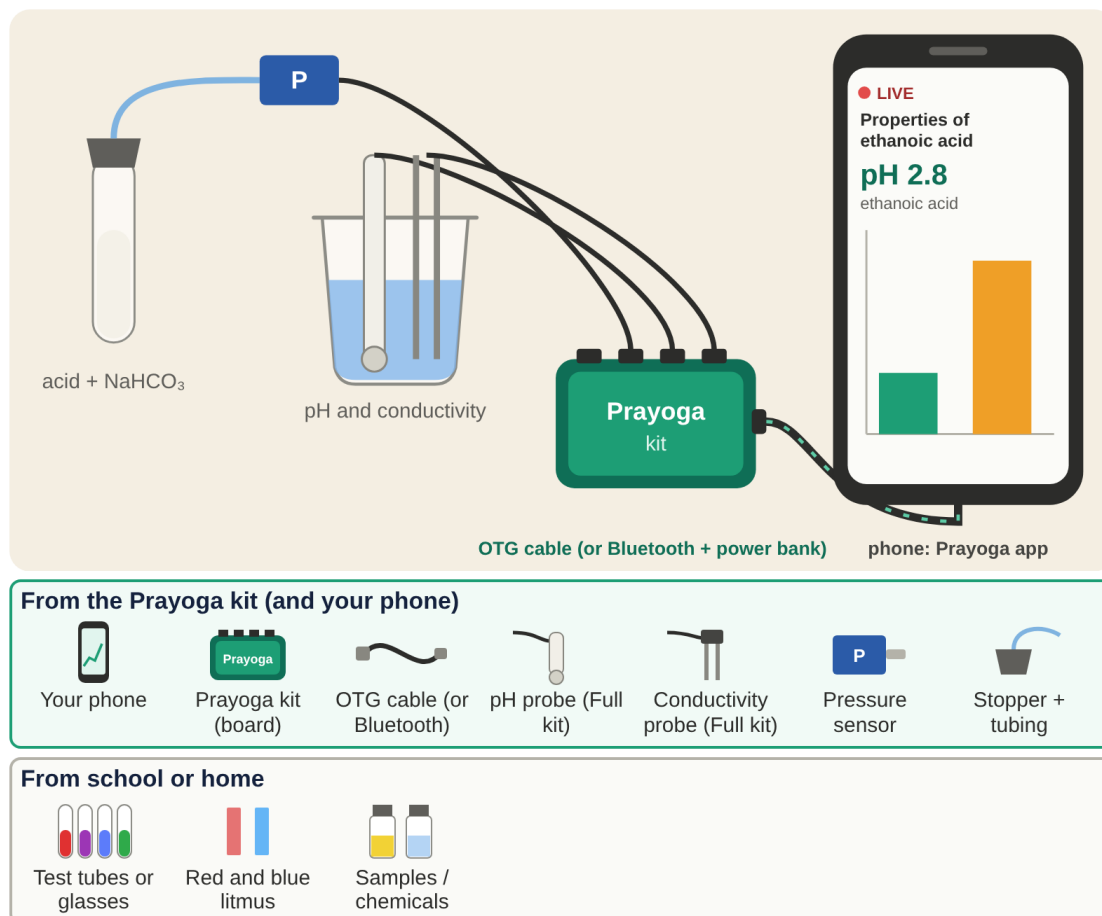
8. Properties of ethanoic acid

Class 10 • Carbon and its Compounds **Full kit**

Name _____ Class _____ Group _____ Date _____

You need: Prayoga kit: pH and conductivity probes (Full kit) and pressure sensor; dilute ethanoic acid (or white vinegar), dilute HCl for comparison, sodium hydrogen carbonate, blue litmus, limewater, test tubes with a one-hole stopper.

Safety: Smell by wafting the air towards your nose; never sniff directly.



Above: how the parts connect, and every instrument you need. The animated version is on the Prayoga setup page.

1 Predict (before you touch the kit)

Compared with dilute HCl, the pH of dilute ethanoic acid will be: ☐ lower ☐ higher ☐ the same

Why do you think so?

2 Measure by hand

1. Odour: waft gently and describe it. Solubility: add 1 mL to 5 mL water and shake. Does it mix completely? Blue litmus: what colour?

3 Set up Prayoga, then observe

Set up Prayoga

- Plug in the pH and conductivity probes; fit the stopper and tube onto the pressure sensor.
- Connect the kit: OTG cable to the phone (cable mode), or power bank in and Bluetooth on (wireless mode). Open the Prayoga app and choose this experiment. It opens the **pH, conductivity and pressure** view and draws the live graph. Calibrate pH in pH 7 buffer when the app asks.
- Tap Start to record and Stop to finish. Tap Save to keep the readings; they can be shared as a spreadsheet.

1. Measure the pH and conductivity of dilute ethanoic acid and of dilute HCl; rinse the probes in between.
2. Put 5 mL ethanoic acid in the stoppered tube joined to the pressure sensor, add a spoon of sodium hydrogen carbonate and record. Pass the gas through limewater.

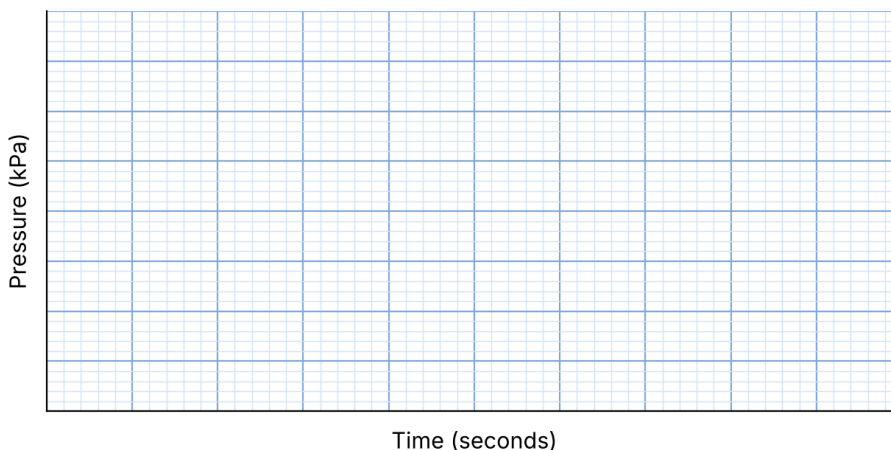
Write your readings in the table on the back.

3 Record your readings · Properties of ethanoic acid

Property	Ethanoic acid	Dilute HCl
Odour		
Mixes with water?		
Blue litmus		
pH probe		
Conductivity		
Pressure rise with NaHCO_3 (kPa)		
Limewater		

3 Plot your results · Properties of ethanoic acid

Plot your points by hand and draw the best line or smooth curve. Choose a scale that uses most of the grid. Then compare with the app's graph.



4 Explain

a) Was your prediction right? If not, what changed your mind?

b) Why is ethanoic acid called a weak acid? Use your pH and conductivity readings.

c) Which gas was given off with sodium hydrogen carbonate? How do you know?

Exam-style questions

1. Write the equation for the reaction of ethanoic acid with sodium hydrogen carbonate. (2 marks)

2. What is glacial acetic acid? (1 mark)

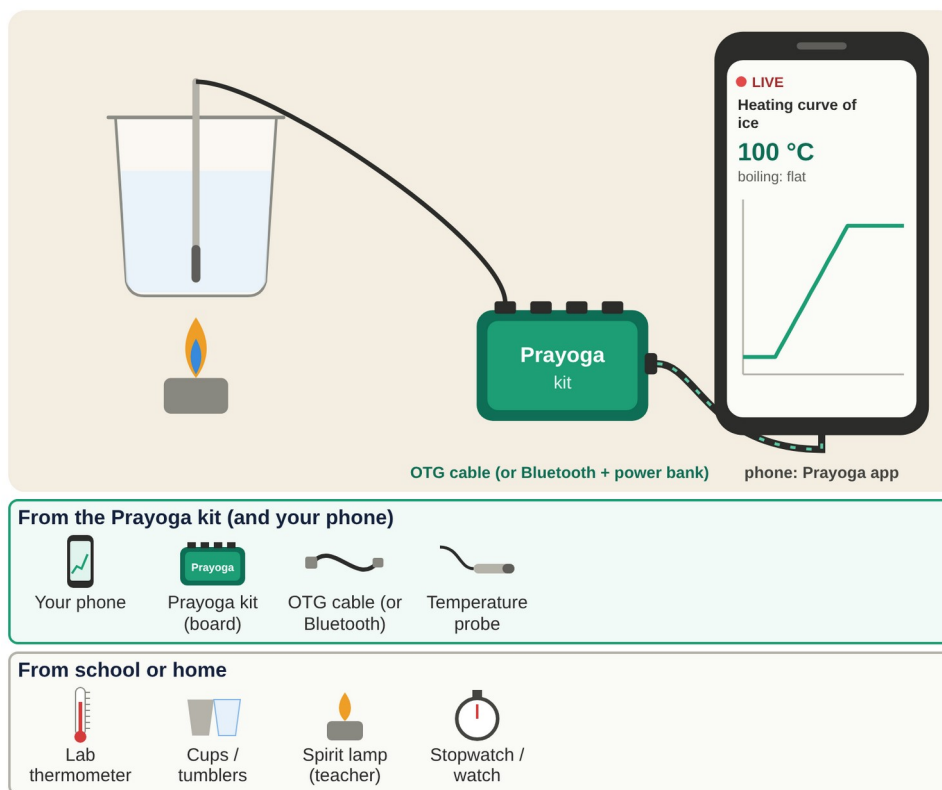
9. Heating curve of ice

Class 9 • Matter in Our Surroundings **Basic kit**

Name _____ Class _____ Group _____ Date _____

You need: Prayoga kit (temperature probe), lab thermometer, crushed ice, steel tumbler, stand, spirit lamp or stove (teacher only), stirrer, watch.

Safety: Only the teacher heats. Do not touch the tumbler. Keep the board and phone away from heat and water.

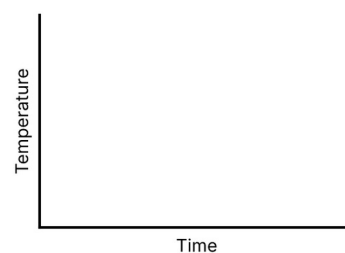


Above: how the parts connect, and every instrument you need. The animated version is on the Prayoga setup page.

1 Predict (before you touch the kit)

While the ice is melting, its temperature will: ☐ rise ☐ stay about the same ☐ fall

Why do you think so?



Sketch the graph you expect

2 Measure by hand

1. Read the thermometer at eye level at the start and when the water boils: _____ °C and _____ °C.

3 Set up Prayoga, then observe

Set up Prayoga

- Plug the temperature probe into the kit.
- Connect the kit: OTG cable to the phone (cable mode), or power bank in and Bluetooth on (wireless mode). Open the Prayoga app and choose this experiment. It opens the **Temperature** view and draws the live graph. Check it shows room temperature before you start.
- Tap Start to record and Stop to finish. Tap Save to keep the readings; they can be shared as a spreadsheet.

1. Put crushed ice, the probe and the thermometer in the tumbler. Start recording in the app.
2. The teacher heats gently while you stir. Record every minute and write the state.

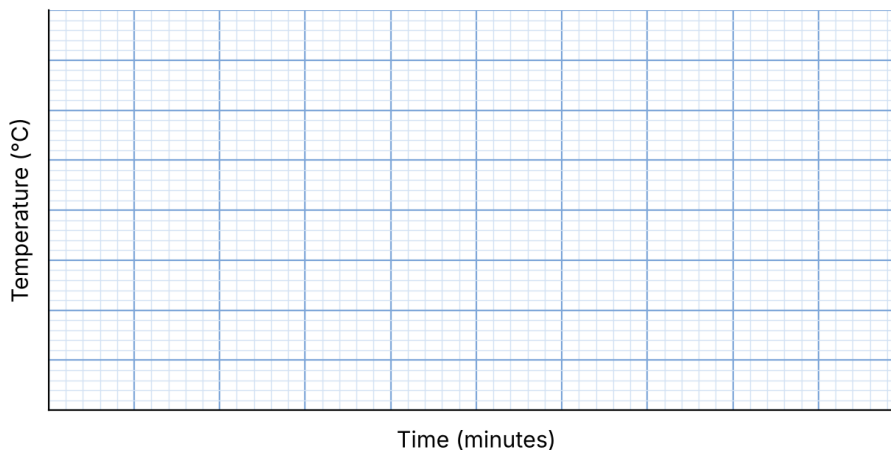
Write your readings in the table on the back.

3 Record your readings · Heating curve of ice

Minute	Temperature (°C)	State (ice + water / water / boiling)
0		
1		
2		
3		
4		
5		
6		
8		
10		
12		

3 Plot your results · Heating curve of ice

Plot your points by hand and draw the best line or smooth curve. Choose a scale that uses most of the grid. Then compare with the app's graph.



4 Explain

a) Was your prediction right? If not, what changed your mind?

b) Where does the heat go during the flat parts of the graph?

c) Your boiling point may be a little below 100 °C. Give one reason.

Exam-style questions

1. What is latent heat of vaporisation? (2 marks)

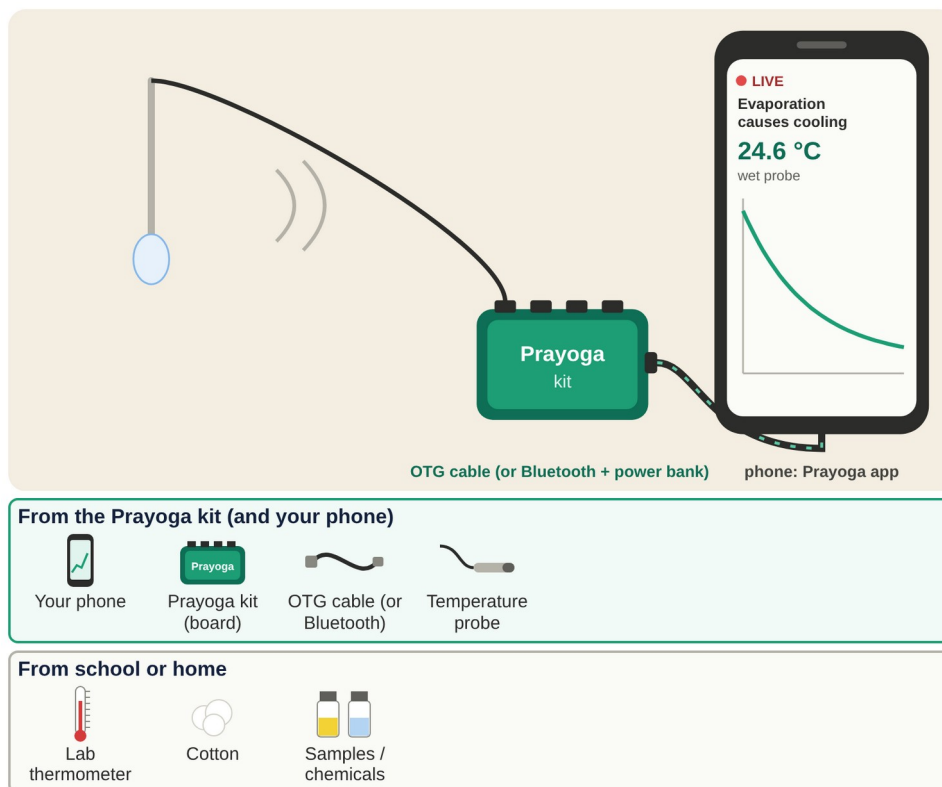
2. Convert 0 °C and 100 °C into kelvin. (1 mark)

10. Evaporation causes cooling

Class 9 • Matter in Our Surroundings **Basic kit**

Name _____ Class _____ Group _____ Date _____

You need: Prayoga kit (temperature probe), lab thermometer, cotton, water at room temperature, hand sanitiser, notebook for fanning.

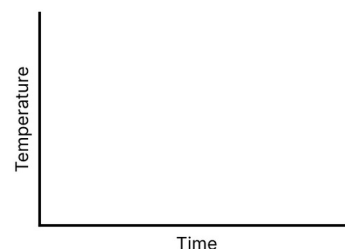


Above: how the parts connect, and every instrument you need. The animated version is on the Prayoga setup page.

1 Predict (before you touch the kit)

A probe wrapped in wet cotton and fanned will read: ☐ warmer ☐ cooler ☐ the same as the dry thermometer

Why do you think so?



Sketch the graph you expect

2 Measure by hand

1. Read the dry thermometer (room temperature): _____ °C.

3 Set up Prayoga, then observe

Set up Prayoga

- Plug the temperature probe into the kit.
- Connect the kit: OTG cable to the phone (cable mode), or power bank in and Bluetooth on (wireless mode). Open the Prayoga app and choose this experiment. It opens the **Temperature** view and draws the live graph. Check it shows room temperature before you start.
- Tap Start to record and Stop to finish. Tap Save to keep the readings; they can be shared as a spreadsheet.

1. Wrap the probe tip in cotton soaked in room-temperature water. Record for 3 minutes in still air, then 3 minutes while fanning.
2. Repeat with cotton soaked in hand sanitiser.

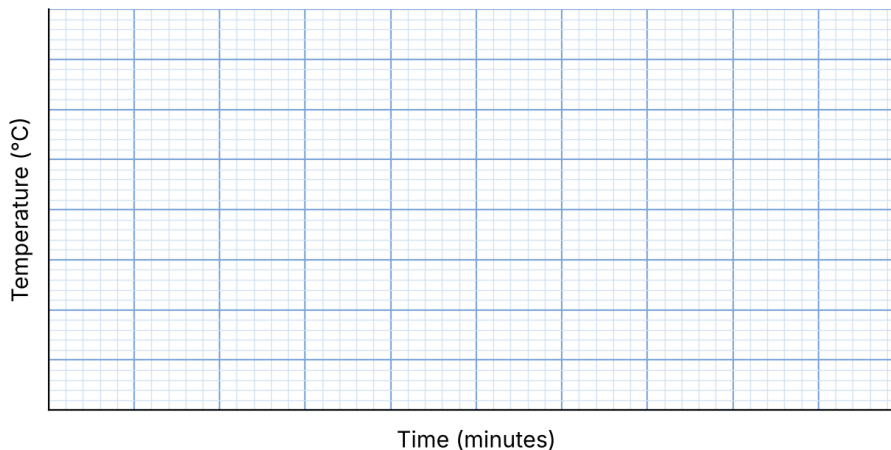
Write your readings in the table on the back.

3 Record your readings • Evaporation causes cooling

Condition	Lowest temperature (°C)	Drop below room temperature (°C)
Wet cotton, still air		
Wet cotton, fanned		
Sanitiser cotton, fanned		

3 Plot your results • Evaporation causes cooling

Plot your points by hand and draw the best line or smooth curve. Choose a scale that uses most of the grid. Then compare with the app's graph.



4 Explain

a) Was your prediction right? If not, what changed your mind?

b) Why does fanning increase the cooling?

c) Why does sanitiser cool more than water?

Exam-style questions

1. Why do we feel cool after sweating? (2 marks)

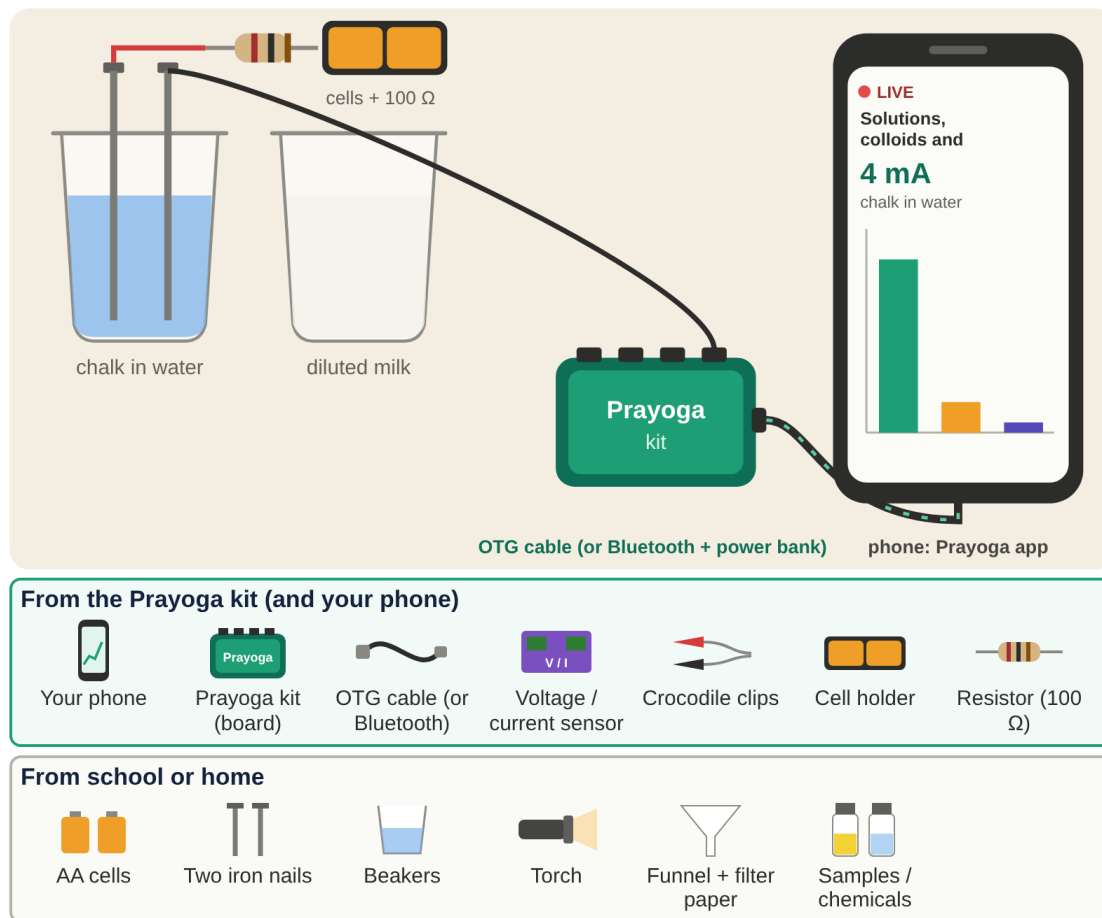
2. List three factors that affect the rate of evaporation. (2 marks)

11. Solutions, colloids and suspensions

Class 9 • Is Matter Around Us Pure **Basic kit**

Name _____ Class _____ Group _____ Date _____

You need: Torch, filter paper and funnel, beakers; salt water, sugar water, chalk powder in water, diluted milk, clean water; two nails in the kit circuit (or conductivity probe).



Above: how the parts connect, and every instrument you need. The animated version is on the Prayoga setup page.

1 Predict (before you touch the kit)

In which beaker will you see the torch beam inside the liquid? ☐ salt water ☐ diluted milk ☐ clean water

Why do you think so?

2 Measure by hand

1. Shine the torch through each beaker from the side in a dim room. Then filter each and look for residue.

3 Set up Prayoga, then observe

Set up Prayoga

- Build the circuit: battery + $\rightarrow$ 100 Ω resistor $\rightarrow$ VIN+; VIN- $\rightarrow$ nail 1; nail 2 $\rightarrow$ battery - and kit GND.
- Connect the kit: OTG cable to the phone (cable mode), or power bank in and Bluetooth on (wireless mode). Open the Prayoga app and choose this experiment. It opens the **Voltage and current** view and draws the live graph. Read the current (mA).
- Tap Start to record and Stop to finish. Tap Save to keep the readings; they can be shared as a spreadsheet.

1. Note whether the beam is visible and whether anything stays on the filter paper.
2. Dip the nails (or probe) in each and read the current.

Write your readings in the table on the back.

3 Record your readings · Solutions, colloids and suspensions

Sample	Beam visible?	Residue on filter?	Current (mA)	Solution / colloid / suspension
Salt water				
Sugar water				
Chalk in water				
Diluted milk				
Clean water				

4 Explain

a) Was your prediction right? If not, what changed your mind?

b) Which tests (beam, filter) separate solutions from suspensions?

c) Why does salt water conduct but sugar water does not?

Exam-style questions

1. Give two differences between a true solution and a suspension. (2 marks)

2. What is the Tyndall effect? (1 mark)

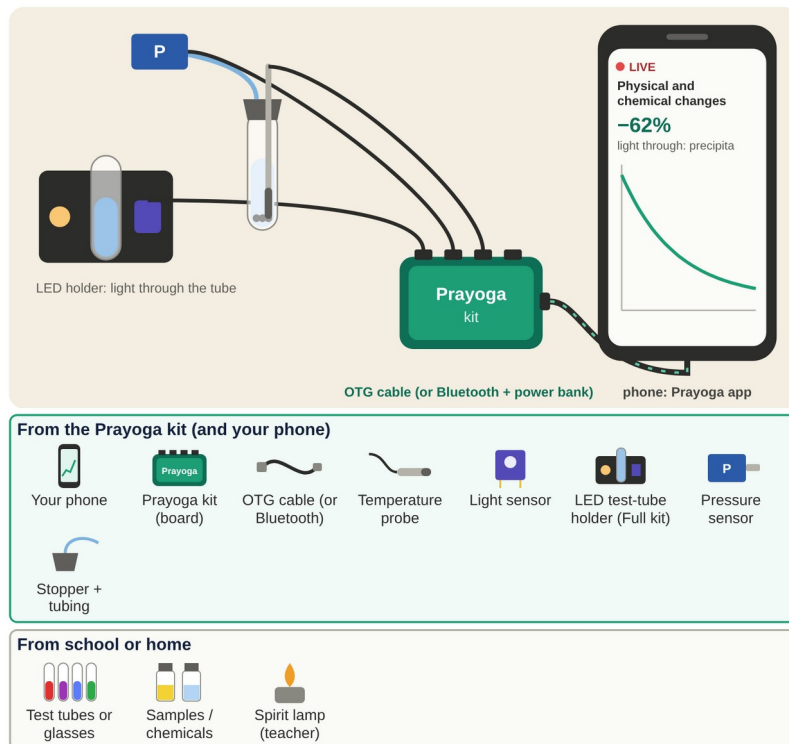
12. Physical and chemical changes

Class 9 • Matter: physical and chemical changes **Full kit**

Name _____ Class _____ Group _____ Date _____

You need: Prayoga kit: temperature probe, pressure sensor, light sensor with the LED test-tube holder (Full kit); test tubes; iron nail and copper sulphate solution; zinc granules and dilute sulphuric acid; copper sulphate crystals; sodium sulphate and barium chloride solutions; magnesium ribbon, tongs and spirit lamp (teacher).

Safety: Goggles on. The teacher heats, burns magnesium and handles acid. Do not look straight at burning magnesium.



Above: how the parts connect, and every instrument you need. The animated version is on the Prayoga setup page.

1 Predict (before you touch the kit)

Write P (physical) or C (chemical) for each reaction in the “Guess” column of the table before you start.

Why do you think so?

2 Measure by hand

- For each change, write what you see by eye: colour change, gas, heat, light or a new solid.

3 Set up Prayoga, then observe

Set up Prayoga
Plug in the temperature probe and the light sensor; put the light sensor in the LED test-tube holder. Fit the stopper and tube onto the pressure sensor.
Connect the kit: OTG cable to the phone (cable mode), or power bank in and Bluetooth on (wireless mode). Open the Prayoga app and choose this experiment. It opens the Temperature, pressure and light view and draws the live graph. Use the readings that suit each reaction.
Tap Start to record and Stop to finish. Tap Save to keep the readings; they can be shared as a spreadsheet.

- Iron nail in copper sulphate, in the LED holder: record the light passing through for 15 minutes.
- Zinc with dilute sulphuric acid in the stoppered tube: record temperature and pressure.
- Mix sodium sulphate and barium chloride in the LED holder: record the light as the solid forms.
- The teacher heats copper sulphate crystals (watch the colour) and burns magnesium ribbon near the light sensor (record the flash).

Write your readings in the table on the back.

3 Record your readings · Physical and chemical changes

Reaction	Guess (P / C)	What you saw	Prayoga reading	Physical or chemical?
Iron + copper sulphate				
Burning magnesium				
Zinc + dilute sulphuric acid				
Heating copper sulphate crystals				
Sodium sulphate + barium chloride				

4 Explain

a) Was your prediction right? If not, what changed your mind?

b) Which readings show that a new substance was formed (gas, heat, solid, colour)?

c) Add a few drops of water to the white copper sulphate after heating. What happens, and what does it tell you?

Exam-style questions

1. Give two differences between a physical change and a chemical change. (2 marks)

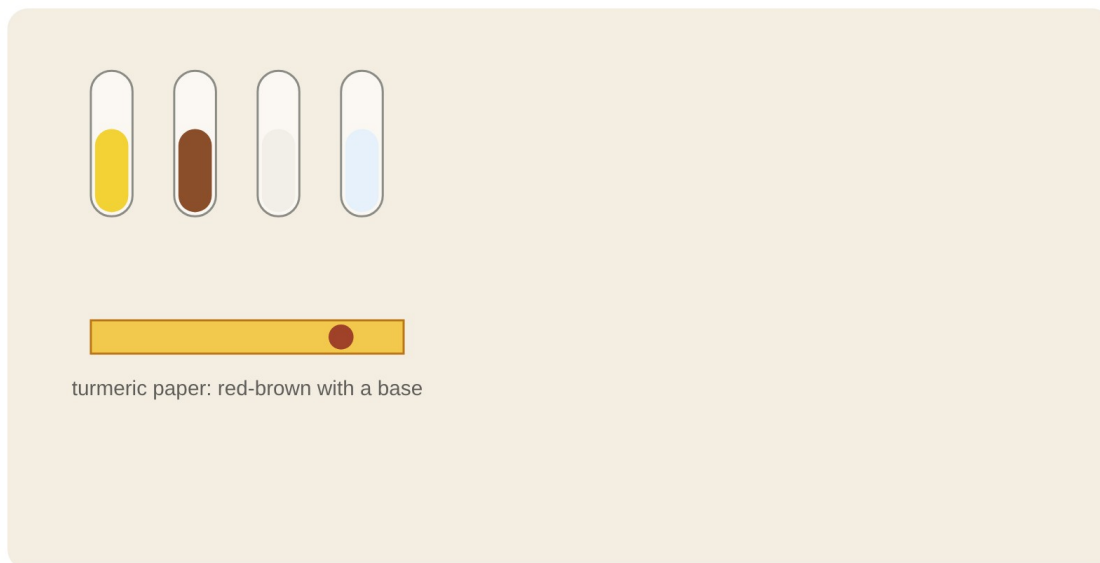
2. Write the word equation for burning magnesium ribbon in air. (1 mark)

13. Acid or base in the kitchen

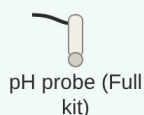
Class 7 • Acids, Bases and Salts **Full kit (or by eye)**

Name _____ Class _____ Group _____ Date _____

You need: Turmeric paper (turmeric paste dried on blotting paper), red cabbage juice, litmus paper if available; lemon juice, tamarind water, soap solution, baking soda solution, curd, tap water.



From the Prayoga kit (and your phone)



From school or home



pH / indicator paper



Test tubes or glasses



Samples / chemicals

Above: how the parts connect, and every instrument you need. The animated version is on the Prayoga setup page.

1 Predict (before you touch the kit)

Guess first: write A (acid), B (base) or N (neutral) in the “Guess” column.

Why do you think so?

2 Measure by hand

1. Make turmeric paper: rub turmeric paste on blotting paper and let it dry.

3 Set up Prayoga, then observe

Set up Prayoga

- Use turmeric paper and cabbage juice first.
- With the Full kit: plug in the pH probe, connect the kit, and open this experiment in the Prayoga app (**pH** view). Rinse the probe between samples.

1. Put a drop of each sample on turmeric paper and in a little cabbage juice.
2. Use the pH probe too if your kit has one.

Write your readings in the table on the back.

3 Record your readings · Acid or base in the kitchen

Sample	Guess	Turmeric colour	Cabbage juice colour	pH probe	Acid / base / neutral
Lemon juice					
Tamarind water					
Soap solution					
Baking soda solution					
Curd					
Tap water					

4 Explain

a) Was your prediction right? If not, what changed your mind?

b) Which foods were acidic? How do they taste?

c) Why does turmeric not show acids?

Exam-style questions

1. Name the acid in lemon, in curd and in tamarind. (2 marks)

2. What is put on an ant sting? Why? (2 marks)

Teacher answer key

1. Hot and cold reactions

- Vinegar + baking soda: drop of about 2–4 °C (endothermic). Ammonium chloride: drop (endothermic). Quicklime: large rise (exothermic).
- Exothermic: energy released as new bonds form. Respiration is exothermic.
- $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2 + \text{heat}$: combination, exothermic.
- Endothermic: absorbs heat, e.g. decomposition of calcium carbonate, photosynthesis, dissolving ammonium chloride.

2. pH of everyday things

- Typical: lemon 2–2.5, vinegar 2.5–3, curd 4–4.5, tap water 7–8, soap 9–10, baking soda about 8.3, toothpaste 8–9. The probe gives decimals, so it is more precise.
- (d) 10.
- Below 5.5 the enamel (calcium phosphate) is attacked by acid from bacteria; basic toothpaste neutralises the acid.

3. Neutralisation curve

- pH rises from about 2.8, changes slowly around 4–5, then rises toward 7–8. With a weak acid and a weak base the jump is gentle, not sharp: a good discussion point.
- Acid + base $\rightarrow$ salt + water.
- Antacids for acidity, baking soda on an ant sting, lime added to acidic soil, toothpaste.

4. Natural indicator from red cabbage

- Acids: red to pink; water: purple; bases: blue to green (yellow in very strong bases).
- Soap is basic.
- Natural indicators: litmus, turmeric, red cabbage, hibiscus.
- Olfactory indicators change smell in acid or base, e.g. onion, vanilla, clove oil.

5. Metals and non-metals: which conduct?

- Metals: shiny, bend, about 10–15 mA (limited by the resistor). Graphite conducts slightly less; charcoal a little or not at all; plastic and wood 0.
- Graphite is the exception: a non-metal that conducts.
- Graphite; mercury.
- Good conductors with low resistance; ductile (can be drawn into wires).

6. Salt water and sugar water

- Salt water: clear current, rising with more salt. Sugar water: about the same as clean water.
- Salt forms ions that carry charge; sugar is covalent and forms no ions.
- Covalent compounds have no free ions or electrons. Sodium chloride: ionic; sugar: covalent.

7. Properties of hydrochloric acid and sodium hydroxide

- HCl: blue litmus turns red, pH about 1–2. NaOH: red litmus turns blue, pH about 12–13.
- Zinc + HCl: pressure rises steadily; the gas burns with a pop (hydrogen). Sodium carbonate + HCl: fast pressure rise; the gas turns limewater milky (CO_2).
- NaOH gives no gas with sodium carbonate (both are basic). Zinc gives hydrogen with NaOH only when warmed, slowly.
- $\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$. $\text{Ca(OH)}_2 + \text{CO}_2 \rightarrow \text{CaCO}_3 + \text{H}_2\text{O}$ (white calcium carbonate makes it milky).

8. Properties of ethanoic acid

- Smell of vinegar; mixes completely with water; turns blue litmus red.
- pH about 2.5–3 (HCl about 1) and much lower conductivity: ethanoic acid only partly forms ions (weak acid).
- Pressure rises and the gas turns limewater milky: carbon dioxide.
- $\text{CH}_3\text{COOH} + \text{NaHCO}_3 \rightarrow \text{CH}_3\text{COONa} + \text{H}_2\text{O} + \text{CO}_2$. Glacial acetic acid: pure ethanoic acid, which freezes at about 16.6 °C.

9. Heating curve of ice

- Flat near 0 °C while ice melts, a steady rise, then flat near the boiling point.

- During the flat parts heat breaks the forces between particles (latent heat), so temperature does not rise.
- Bengaluru is about 900 m above sea level, so water boils at about 97 °C; impurities and thermometer error also matter.
- Latent heat of vaporisation: heat needed to change 1 kg of liquid into vapour at its boiling point. 273 K and 373 K.

10. Evaporation causes cooling

- Water: drop of about 2–5 °C, more when fanned. Sanitiser (alcohol) evaporates faster, so the drop is larger.
- Evaporating liquid takes latent heat from the surface, which cools it; fanning removes the vapour.
- Sweat takes heat from the skin as it evaporates.
- Surface area, temperature, humidity, wind speed.

11. Solutions, colloids and suspensions

- Salt and sugar water: no beam, no residue (solutions). Milk: beam visible, no residue (colloid). Chalk: beam visible, residue (suspension).
- Only salt water conducts well: it contains ions.
- Solution: particles too small to see, does not settle, passes through filter. Suspension: particles visible, settle, stay on filter.
- Tyndall effect: scattering of a light beam by colloid particles.

12. Physical and chemical changes

- Iron + copper sulphate: blue colour fades (more light passes), brown copper coats the nail: chemical. Magnesium: bright flash on the light sensor, white ash: chemical. Zinc + acid: temperature rises a few °C and pressure rises (hydrogen): chemical. Barium chloride + sodium sulphate: light drops sharply as white barium sulphate forms: chemical.
- Heating copper sulphate crystals: blue turns white and water droplets form; adding water turns it blue again. Many textbooks call this a physical change because it reverses; follow your textbook's answer.
- Magnesium + oxygen → magnesium oxide.

13. Acid or base in the kitchen

- Lemon, tamarind, curd: acids. Soap, baking soda: bases. Tap water: about neutral. Acids taste sour.
- Turmeric turns red-brown only with bases.
- Lemon: citric acid; curd: lactic acid; tamarind: tartaric acid.
- Baking soda (a base) neutralises the formic acid from the ant.